

A SYSTEM FOR DISTRIBUTING CONTENTS ON A NETWORK, A
METHOD OF DISTRIBUTION AND A COMPUTER PROGRAM
PRODUCT THEREFOR

5 BACKGROUND OF THE INVENTION

1. Field of the Invention

10 The present invention relates to a
distribution system for distributing procedures
(application programs etc) and/or data (jointly
referred to as "contents") to a plurality of
clients such as clients present over a wide area
and/or clients provided in mobile units. In
15 particular, it relates to a distribution system
whereby efficient distribution can be performed
which is adapted to dynamic changes in demand for
the procedures or data, by utilizing distribution
technology such as the Internet.

20 2. Description of the Related Art

25 Conventionally, distribution systems whereby
procedures or data are distributed to a plurality
of clients are utilized for example when product
catalogues or inventory information etc are
distributed to sales companies or small retailers

worldwide, or when an information provider distributes programs or data for the provision of services to a large number of members, or when data such as map information or weather information or viewer programs for the data are distributed to vehicle-mounted/mobile information terminals.

Figure 19 is a layout diagram showing an example of a conventional distribution system. A distribution server 1 (parent server) is a server constituting the distribution source for procedures and/or data and a plurality of clients 3 constitute the distribution destinations of the procedures and/or data. In the case, a single distribution server 1 distributes the requested procedures or data in response to requests from all the clients 3. Such a distribution mode is frequently employed by an information provider when providing a distribution service for procedures or data using the Internet.

Figure 20 is a layout diagram illustrating another example of a prior art distribution system. The distribution system shown in Figure 20 attempts to disperse the load on the parent server 1 and the network connected to parent server 1 by dividing the distribution destinations for the procedures or data into a plurality of areas, and

providing one or a plurality of child servers 2 for each area. In this distribution mode, a client 3 is associated with a specific area, and receives distribution of procedures or data specific to this area from the child server 2 that is responsible for this area. Also, procedures or data that are common to all areas are directly supplied from parent server 1. Such distribution systems are utilized by information providers that distribute procedures or data on a world scale, and by enterprises having a large number of clients 3 on a national/world scale.

However, with the conventional distribution system shown in Figure 19, since, as described above, a single distribution server 1 performs distribution of procedures or data to all the clients 3, if there are a large number of simultaneous distribution requests, the load on the distribution server and/or network is increased, giving rise to the problem that in some cases a condition may be produced in which these become unusable.

Furthermore, in the case of the distribution system shown in Figure 20, although, as mentioned above, this has a configuration whereby the load on the parent server 1 and the network connected to the parent server 1 is dispersed, when a large

number of distribution requests to parent server 1 are generated simultaneously, in order to prevent this from resulting in load concentration, on each occasion, it is necessary to perform an operation to change over the distribution source from parent server 1 to the child server 2 that is closest to client 3. Although, in order to render such an operation unnecessary, means may be adopted whereby the parent server 1 and all of the child servers 2 are provided with all of the procedures or data that are to be distributed, this gives rise to the problem that storage equipment of large capacity must be provided at all of child servers 2, since even procedures or data in respect of which the frequency of use (distribution requests) is extremely low have to be stored therein.

SUMMARY OF THE INVENTION

Accordingly, in a distribution system whereby procedures or data are distributed to a plurality of clients, an object of the present invention is to provide a distribution system, distribution method, and program product therefor whereby the load on the parent server or the network connected with the parent server can be alleviated and

automatic changeover of the distributing server in accordance with fluctuating distribution requests and alleviation of the load on the distribution system manager and users can be achieved.

5 In order to achieve the foregoing object, according to one aspect of the present invention, in a distribution system having a parent server and a plurality of child servers, these being arranged to be capable of connection with a
10 plurality of clients through communication circuits, the parent server uses the received client position information and contents identification information to select the child server that is closest to the client that
15 originated the distribution request and that holds the contents requested for distribution, and communicates this to the client that originated the distribution request, whereupon the selected child server distributes the contents that were
20 requested for distribution in response to a request from the client that originated the distribution request. Consequently, according to the present invention, the amount of information transfer between the clients and the parent server
25 is reduced, and the load on the parent server and the network connected to the parent server can be alleviated. Also, since the distribution source is

automatically changed over to the child server that is closest to the client, the load on the manager and users of the distribution system can be alleviated.

5 In order to achieve the above object, according to a further aspect of the present invention, there is provided a distribution system having a parent server and a plurality of child servers, being arranged to be capable of
10 connection with a plurality of clients through communication circuits, so that contents held by the parent server and/or the child servers are distributed to the clients; wherein the parent server comprises: an unit that receives position
15 information of the clients and identification information of the contents whose distribution is requested by the clients; and an unit that selects the child server which holds the contents whose distribution is requested and which is closest to
20 the client that originates the distribution request, using the received client position information and identification information of the contents, and that notifies the client that originates the distribution request of the
25 position information of the selected child server; and the child server comprises an unit that distributes the contents whose distribution is

requested in response to a request of the client
originating the distribution request.

Furthermore, according to the invention, in a
preferred embodiment, said parent server comprises
an unit that ascertains the presence or absence of
a distribution request or the frequency of
distribution requests for said contents from said
clients situated in an area for which said child
server is responsible, and said child server
comprises an unit that acquires and copies from
said parent server said contents that are not held
by said child server, on the basis of the
ascertained presence or absence of a distribution
request or the frequency of distribution requests.

Furthermore, according to the invention, in a
preferred embodiment, said child server comprises:
an unit that ascertains the presence or absence of
a distribution request or the frequency of
distribution requests for said contents from said
clients situated in the area for which said child
server is responsible, and an unit that deletes
from said child server said contents which are
held by said child server on the basis of the
ascertained presence or absence of a distribution
request or the frequency of distribution requests.

Furthermore, according to the invention, in
another embodiment, said child server comprises:

an unit that deletes from said child server said contents which are held by said child server on the basis of the presence or absence of a distribution request or the frequency of distribution requests ascertained by said parent server.

In order to achieve the above object, according to a further aspect of the present invention, there is provided a distribution system having a parent server and a plurality of child servers, the being arranged to be capable of connection with a plurality of clients through communication circuits, so that contents held by the parent server and/or the child servers are distributed to the clients; wherein the parent server comprises an unit that ascertains the presence or absence of a distribution request or the frequency of distribution requests for said contents from the clients situated in an area for which the child server is responsible, and the child server comprises an unit that acquires and copies from the parent server the contents which are not held by said child server on the basis of the ascertained presence or absence of a distribution request or the frequency of distribution requests.

Furthermore, according to the invention, in a

preferred embodiment, said child server comprises:
an unit that ascertains the presence or absence of
a distribution request or the frequency of
distribution requests for said contents from the
clients situated in the area for which said child
server is responsible; and an unit that deletes
from said child server said contents which are
held by said child server on the basis of the
ascertained presence or absence of a distribution
request or the frequency of distribution requests.

Furthermore, according to the invention, in
another embodiment, said child server comprises an
unit that deletes from said child server said
contents which are held by said child server on
the basis of the presence or absence of a
distribution request or the frequency of
distribution requests ascertained by said parent
server.

In order to achieve the above object,
according to a further aspect of the present
invention, there is provided a computer program
product that operates on a parent server in a
distribution system having the parent server and a
plurality of child servers, being arranged to be
capable of connection with a plurality of clients
through communication circuits, so that contents
held by the parent server and/or the child servers

are distributed to the clients, said computer program product comprising: a step of selecting the child server that holds the contents whose distribution is requested and that is closest to the client that made the distribution request on the basis of position information of the client that makes a distribution request for the contents and identification information of the contents whose distribution is requested by the client; and a step of communicating the position information of the selected child server to the client that makes the distribution request.

In order to achieve the above object, according to a further aspect of the present invention, there is provided a computer program product that operates on a parent server in a distribution system having the parent server and a plurality of child servers, being arranged to be capable of connection with a plurality of clients through communication circuits, so that the contents held by the parent server and/or the child servers are distributed to the clients, said computer program product comprising: a step of ascertaining the presence or absence of a distribution request or the frequency of distribution requests in respect of the contents from the clients situated within an area for which

the child server is responsible; and a step of giving the child server notification to prompt copying to the child server from the parent server of the contents that are not held by the child server, or deleting from the child server the contents that are held by the child server, on the basis of the ascertained presence or absence of a distribution request or the frequency of distribution requests.

10 In order to achieve the above object, according to a further aspect of the present invention, there is provided a computer program product that operates on a child server in a distribution system having a parent server and a plurality of child servers, being arranged to be 15 capable of connection with a plurality of clients through communication circuits, so that the contents held by the parent server and/or the child servers are distributed to the clients, said computer program product comprising: program code 20 which copies to the child server from the parent server the contents that are not held by the child server, or deletes from the child server the contents that are held by the child server, on the basis of presence or absence of a distribution 25 request or frequency of distribution requests for the contents from the clients situated in an area

for which the child server is responsible.

In order to achieve the above object,
according to a further aspect of the present
invention there is provided a method of
5 distributing contents to clients in a distribution
system including a parent server and a plurality
of child servers, being arranged to be capable of
connection with the plurality of clients through
communication circuits, comprising: a step in
10 which the parent server receives identification
information of the contents whose distribution is
requested and position information of the client
that makes a request for distribution of the
contents; a step in which the parent server
15 selects, on the basis of the received position
information of the client and contents
identification information, the child server which
has the contents that is requested for
distribution and which is closest to the client
20 that makes the request for distribution, and
notifies the client that makes the request for
distribution of the position information of the
selected child server; and a step in which the
selected child server distributes the contents
25 whose distribution is requested in response to a
request of the client that makes the distribution
request.

In order to achieve the above object,
according to a further aspect of the present
invention, there is provided a method of
distributing contents to clients in a distribution
5 system including a parent server and a plurality
of child servers, being arranged to be capable of
connection with the plurality of clients through
communication circuits, comprising: a step of
ascertaining the presence or absence of a
10 distribution request or the frequency of
distribution requests in respect of the contents
from the clients situated in an area for which the
child server is responsible; a step of copying the
contents which are not held on the child server
15 from the parent server to the child server, or
deleting the contents which are held on the child
server from the child server on the basis of the
ascertained presence or absence of a distribution
request or the frequency of distribution requests;
20 and a step of performing distribution from the
child server in response to a distribution request
for contents held by the child server from the
clients situated in the area for which the child
server is responsible.

25 In order to achieve the above object,
according to a further aspect of the present
invention, there is provided a distribution system

comprising a parent server, a plurality of child servers and a plurality of clients which are connected through communication circuits so that contents held by the parent server and/or the child servers are distributed to the clients, wherein: the clients communicate to the parent server position information of the clients and identification information of the contents whose distribution is requested by the clients, the parent server selects, on the bases of the position information of the client and the contents identification information that is communicated thereto, the child server that holds the contents whose distribution is requested and that is closest to the client that originates the distribution request, and communicates the position information of the selected child server to the client originating the distribution request, and the client that originates the distribution request receives the contents whose distribution is requested from the selected child server, on the basis of the position information of the selected child server.

Furthermore, according to the invention, in a preferred embodiment, receipt performed by said client of contents from said selected child server is conducted using a program downloaded to said

client from said parent server when the request for distribution of said contents is made.

Further objects and features of the present invention will be apparent from the embodiments of the invention described below.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a schematic layout diagram of a distribution system to which the present invention is applied;

Figure 2 is a layout diagram showing a first embodiment of a distribution system to which the present invention is applied;

Figure 3 is a view showing an example of location information;

Figure 4 is a view showing an example of an access log;

Figure 5 is a flowchart showing the operation of a distribution system according to a first embodiment;

Figure 6 is a view showing a practical example of a distribution system according to the first embodiment;

Figure 7 is a distribution system layout diagram according to a second embodiment;

Figure 8 is a flowchart showing the operation

of a distribution system according to the second embodiment;

Figure 9 is a flowchart showing the operation of a distribution system according to the second
5 embodiment;

Figure 10 is a flowchart showing the operation of a distribution system according to the second embodiment;

Figure 11 is a view showing a practical
10 example of a distribution system according to the second embodiment;

Figure 12 is a layout diagram of a distribution system according to a third
embodiment;

Figure 13 is a flowchart showing the operation
15 of a distribution system according to the third embodiment;

Figure 14 is a flowchart showing the operation of a distribution system according to the third
20 embodiment;

Figure 15 is a flowchart of the case where a deletion list is generated at a parent server-side device according to the third embodiment;

Figure 16 is a flowchart of the case where a
25 deletion list is generated at the parent server-side device according to the third embodiment;

Figure 17 is a flowchart of the case where a

deletion list is generated at the parent server-side device according to the third embodiment;

Figure 18 is a view showing a practical example of a distribution system according to the third embodiment;

Figure 19 is a layout diagram illustrating an example of a prior art distribution system; and

Figure 20 is a layout diagram illustrating a further example of a prior art distribution system.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Embodiments of the present invention are described below with reference to the drawings. However, the technical scope of the present invention is not restricted by these embodiments. Identical or similar items in the drawings are given the same reference numerals or reference symbols in the description.

Figure 1 is a schematic layout diagram of a distribution system to which the present invention has been applied. The distribution system comprises parent server 1, child servers 2, clients 3 and parent server-side device 4, child server-side devices 5, and client-side devices 6 etc respectively provided therefor. Parent server 1, child servers 2, and clients 3 are constituted

by computer systems etc and are respectively connected through communication circuits. Also, parent server-side device 4, child server-side device 5 and client-side device 6 are preferably constituted by software (a program); in this case, the software constituting the client-side device 6 is previously installed on client 3, or, if necessary (when there is a distribution request etc), is downloaded from parent server 1 to client 3.

Parent server 1 stores and manages procedures and data that are common to all distribution ranges and distributes the procedures and data to the child servers 2 or clients 3 in accordance with requirements. Child servers 2 are servers that distribute procedures or data to clients 3 belonging to within the area for which they are responsible; one or more child servers is provided for each area. The "areas" are respective ranges into which the entire range of distribution is geographically or logically divided. The clients 3 are the distribution destinations of the procedures or data; a plurality of clients may be present in a distribution range.

Location information 7 is child server information indicating the whereabouts of the procedure or data; using this information, parent

server-side device 4 notifies client 3 of the identity of the child server which is the distribution source for the requested procedures or data and, if necessary, copies the procedure or data to the child server 2. Also, child server-side device 5, in co-ordination with parent server-side device 4, copies and registers the necessary procedures or data to the child server 2 and deletes procedures or data which are no longer required from child server 2. Client-side device 6 automatically changes over the server from which receives the distribution in accordance with information communicated to it from parent server-side device 4.

Procedures or data which are the subject of distribution are hereinbelow called "contents"; contents which are common to the entire distribution region and are managed by parent server 1 are called "global contents", while contents which are peculiar to each individual area and are held on each child server 2 are called "local contents".

Also, although, in Figure 1, contents distribution is performed with a two-level arrangement, a three-level arrangement could be adopted. In this case, the arrangement is adopted that the areas covered by child servers 2 are

further divided into a plurality of sub-areas, grandchild servers being provided which are responsible for each sub-area, the original child servers 2 constituting parent servers in respect of these new grandchild servers. Three embodiments of distribution systems to which the present invention is applied will be described below for the case of two levels.

Figure 2 is a layout diagram showing a first embodiment of a distribution system to which the present invention has been applied. In the distribution system of this embodiment, the position of the closest child server 2 having the contents whose distribution is requested is notified from parent server-side device 4, and the client-side device 6 acquires these contents from the closest child server 2, as a result, automatical changeover of the distribution source of the contents to client 3 is achieved.

As described with reference to Figure 1, the distribution system shown in Figure 2 is arranged in two layers comprising parent server 1, child servers 2, and clients 3, and distributes contents to clients 3 from parent server 1 or child servers 2. Three child servers 2a, 2b, 2c are shown by way of example in Figure 2; the ranges for which these respective child servers are responsible are child

server coverage areas 9a, 9b and 9c in the Figure.

The location information 7 that is prepared at the parent server side is information indicating in which child servers 2 the contents (global contents) that are managed by parent server 1 are stored (copied); an example thereof is shown in Figure 3. This example is a case in which a single child server 2 is responsible for a single area; the server ID and area ID indicate the identifier of the child server 2 and the child server coverage area 9 corresponding to the respective child server 2. Also, the title of the contents is indicated in section a in the Figure, and what contents have been copied from parent server 1 to each child server 2 is indicated in section b. The method of implementation may be adopted that the information of this section b is represented in bit form, and the information as to what global contents are provided at a child server 2 is represented by a single integer.

Also, the access log 8 in Figure 2 is a log of distribution request access from client 3 to parent server 1; an example thereof is shown in Figure 4. As shown in the Figure, information such as the access time-point, the client ID, the ID of the area to which the client 3 belongs, and the ID of the contents whose distribution was requested

etc are shown in time sequence in access log 8.
This access log 8 is employed for calculation of
the frequency of access, as will be described, and
may contain the minimum necessary information for
this purpose.

Next, client-side device 6 makes a request to
parent server 1 for a distribution of contents and
accepts the requested contents; client-side device
6 may be constantly actuated at client 3, or may
be actuated when required by the user of client 3.
If it is constituted by software, as described
above, it may be installed beforehand on client 3,
or may be downloaded from parent server 1 when a
distribution request is made. When a distribution
request is made, client-side device 6 sends to
parent server-side device 4 information such as
the contents ID for uniquely determining the
contents whose distribution is requested, and
information such as the area ID identifying the
area in which the client 3 is currently located.
The desired contents are then acquired from child
server 2 by utilizing the location information of
the contents (i.e. the position of the closest
child server 2 which has the contents in question)
which is communicated in reply thereto from parent
server-side device 4.

Parent server-side device 4 extracts from

location information 7 information as to the identities of the child servers 2 on which the contents requested from client-side device 6 are present (have been copied), and, using the information of area 9 sent from client-side device 6, selects from these the closest child server 2 to the client 3 in question, and returns this position information to client 3. Also, the identity of the area 9 and the identity of the client 3 thereof from which the request was made and the identity of the requested item of contents are logged in access log 8. Parent server-side device 4 operates continuously at parent server 1.

Figure 5 is a flowchart illustrating the operation of the distribution system according to the first embodiment. The operation when a client 3 requests distribution of global contents C1 will now be described with reference to Figure 2 and Figure 5. As shown in Figure 2, client 3 is situated in area 9b that is covered by child server 2b. First of all, client-side device 6 notifies parent server-side device 4 of information uniquely identifying area 9b and contents C1 (step S1 of Figure 5). Using these items of information, parent server-side device 4 then searches location information 7 to ascertain the identity of child server 2 on which the

requested contents C1 are present (step S2 of Figure 5).

Next, from the results of this search and the information regarding the aforementioned area 9b that has been sent, the closest child server 2 to the client 3 which made the request having the contents C1 is selected, and its position information (for example URL) is returned (step S3 and S4 in Figure 5). If the child server 2b that covers the area 9b in which the requesting client 3 is situated has contents C1, the position information of child server 2b is sent; if it does not have these contents, the position information of the child server, for example child server 2c which is closest to area 9b is sent. Also, if the result of the search is that no server is found which has the requested contents C1, an error message is returned (step S5 of Figure 5).

When client-side device 6 receives the position information, it uses this position information to make a request for distribution to the closest child server 2 having contents C1, and receives distribution of contents C1 (steps S6, S7 and S9 in Figure 5). As described above, if child server 2b has contents C1, distribution is received from child server 2b; if not, distribution is received from the closest child

server, for example child server 2c. Also, if child server 2b that covers the area 9b in which the requesting client 3 is situated does not have the desired contents C1, it may be arranged for contents C1 to be distributed from parent server 1.

As shown in Figure 2, even if the request is made when the requesting client 3 moves (is transferred) and is situated in child server coverage area 9c, the same action as described above is performed, with the result that the requesting client 3 receives contents distribution from child server 2c if child server 2c has contents C1 or, if not, receives contents distribution either from the closest child server 2 (for example child server 2b) or from parent server 1.

It should be noted that it could be arranged for the client-side device 6 to make a distribution request directly to this child server 2b if it is found that child server 2b that covers this area 9b has the desired contents C1 or if distribution of local contents specific to this area 9b is received.

Figure 6 is a view showing a practical example of a distribution system according to the first embodiment. In this practical example, client 3 is a vehicle-mounted information terminal that

receives distribution of map information (MAP) from a server, this being utilized by displaying it on a map viewer.

A General Information Center is positioned as parent server 1 in which all the map information is provided, the server being the distribution source of the map information. The Tokyo Information Center and Kanagawa Information Center shown in the drawing are examples of child servers associated with General Information Centers that cover respectively the Tokyo area and Kanagawa area and are positioned as child servers 2b, 2c. Also, in this example, it is assumed that client 3 (vehicle-mounted information terminal) is in the course of movement from the Tokyo area to the Kanagawa area in order to participate in an event that is being performed in the Kanagawa area.

First of all, client 3 makes a request to the General Information Center for distribution of map information (Tokyo MAP) of the Tokyo area in which it is currently situated. At this point, the information of the area where client 3 is situated is generated using its current position obtained from for example a GPS receiver. The position information (URL) of the Tokyo Information Center (child server 2b) having the Tokyo MAP is returned by executing an operation as described above at

parent server 1, which is the General Information Center. Client-side device 6 thereby receives distribution of the Tokyo MAP from the Tokyo Information Center.

5 Also, if it is desired to view beforehand while in the Tokyo area the map information of the Kanagawa area (Kanagawa MAP) which is the destination, since the Tokyo Information Center of the area in which the client 3 is situated does
10 not have a Kanagawa MAP, the position information of the closest Kanagawa Information Center (child server 2c) is returned, and, using this, distribution thereof is received from the Kanagawa Information Center. On the other hand, when client
15 3 moves, at the stage where the client enters the Kanagawa area, a distribution request for the Kanagawa MAP is made, producing a configuration in which distribution is received from child server 2c (Kanagawa Information Center) that covers this
20 area.

 As described above, since, with a distribution system according to the first embodiment, the communication between the parent server 1 and client 3 consists merely of an inquiry for the
25 position information as to the identity of a child server 2 from which the desired contents distribution can be received, the amount of

information to be transferred can be greatly reduced compared with the conventional method.

Also, since the child server 2 constituting the distribution source is automatically changed over

5 in accordance with the location where the client 3 is situated, there is no need for action by the user of client 3 or the server manager to change over the distributing server.

Next, a second embodiment of a distribution
10 system employing the present invention will be described. Figure 7 is a layout diagram of a distribution system according to the second embodiment. In this distribution system, if the
15 child server of the area 9 in which the client 3 constituting the distribution destination is situated does not have the contents to be distributed, these contents are automatically
copied from parent server 1 to this server 2 so
20 that they can be distributed from this child server 2 to client 3.

As shown in Figure 7, in the distribution system of this embodiment, just as shown in Figure 1 and Figure 2, there is provided a two-layer
25 distribution arrangement comprising a parent server 1, child servers 2 and clients 3. Child server coverage area 9 is the range of distribution for which child server 2 is

responsible; location information 7 and access log 8 have the same content as described above with reference to the first embodiment.

In this distribution system, parent server-side device 4 is constantly actuated at parent server 1 and analyses the access log 8 at fixed time intervals so as to ascertain the existence of distribution requests for the items of content (global) in each area (each child server 2). Also, if prescribed contents are copied to a prescribed child server 2, this fact is reflected in the location information 7.

Child server-side device 5 is constantly actuated on child server 2 and periodically accesses parent server-side device 4 to inquire as to the existence of contents distribution requests from the area 9 for which it is itself responsible. If there is a distribution request but the contents are not present, it copies the contents in question (for example C1 of Figure 7) from parent server 1 and subsequently distributes these contents from child server 2 to client 3.

Figure 8, Figure 9 and Figure 10 are flowcharts showing the operation of a distribution system according to the second embodiment. The operation of this distribution system is described below with reference to these Figures and to

Figure 7. First of all, as shown in Figure 8, processing to compile a copy list 10 is executed at the side of parent server 1. Parent server-side device 4 repeatedly executes the following

5 processing in respect of each child server 2 at fixed time intervals. First of all, it initializes the copy list 10 in respect of a child server 2 that is the subject of processing (step S1 of Figure 8). "Copy list" 10 means a list of the contents to be copied to the server 2 in question.

10 Next, the following processing is repeatedly executed for each item of contents held by the parent server 1. First of all, from access log 8, it counts the number of accesses constituting distribution requests in respect of the contents in question from within area 9 for which the child server 2 in question is responsible (step S2 in Figure 8). Next, it calculates the access frequency from these access numbers (step S3 in

15 Figure 8). For the calculation of access frequency, the method may be adopted for example of dividing the number of accesses by the time over which the log is compiled.

20 Next, it searches the location information 7 to ascertain whether the contents in question are currently present on child server 2 in question (step S4 in Figure 8). If, as a result, it finds

25

that these contents are not present, and the access frequency is greater than a pre-set threshold value (step S5 in Figure 8), it adds the name of the contents in question to the copy list 10 (step S6 in Figure 8). It should be noted that, although, in the above description, the access frequency was employed for the decision regarding copying, it would be possible to make the decision to perform copying simply when the number of accesses exceeds a prescribed value (value of 1 or more). For example, if the aforementioned prescribed value is set as 1, if there is even a single request for distribution, a decision to effect copying on to child server 2 is made.

A copy list 10 is generated for child server 2 in question by executing processing as above for each item of contents. Such copied lists 10 are respectively generated for all the child servers 2.

Next, an inquiry is made from the side of the child server 2 as to whether any distribution requests have been made to parent server 1. Figure 9 shows the operation of child server-side device 5 and parent server-side device 4 at this point. First of all, child server-side device 5 periodically initializes copied list 11 (step S7 of Figure 9) and enquires of parent server-side device 4 whether there have been any contents

distribution requests from the area 9 for which it is itself responsible (step S8 in Figure 9). The "copied list" 11 is a list of the items of contents that have been copied to child server 2 in question.

After confirming the identity of the child server 2 making the request (step S9 in Figure 9), the parent server-side device 4 that is in receipt of this request ascertains whether there are any items of contents which should be copied to the corresponding copy list 10 (step S10 in Figure 9). If there are items of contents that should be copied, it returns the copy list 10 to the child server 2 in question (step S11 in Figure 9). It should be noted that various methods of implementing the returned copy list 10 may be employed, such as implementation in the form of a set of flags, each flag of which indicates whether each item of contents is to be copied or not respectively.

When child server-side device 5 has received copy list 10, it fetches the items of contents included therein from parent server 1 (step S12 of Figure 9), and adds their names to the copied list 11 (step S13 in Figure 9), and registers these items of contents at its own server (child server 2) (step S14 in Figure 9). At the time-point where

the above processing has been completed, the copied list 11 is sent to parent server-side device 4 (step S15 in Figure 9), thereby giving notification that the contents in question have become capable of distribution also at the side of child server 2. Just as in the case of the copy list 10 described above, a method of implementation such as implementation in the form of a set of flags may be adopted for this copied list 11 also. Also, the notification to parent server-side device 4 may be effected every time registration of each item of contents on to child server 2 is completed.

For each item of contents included in the copied list 11, parent server-side device 4, after it has received the notification, deletes the name of the contents in question from the copy list 10 of the child server 2 in question (step S16 of Figure 10) and, in addition, makes a record in location information 7 to the effect that the item of contents in question has become capable of being distributed by the child server 2 in question (step S17 in Figure 10). The item of contents in question can thereafter be distributed from child server 2.

Although, in the above description, a method was described wherein inquiry was made

periodically from the side of child server 2, a method could be adopted wherein copying of contents is prompted by accessing child server 2 periodically from the side of parent server 1, in combination with the generation of copy list 10 at parent server-side device 4 described with reference to Figure 8.

Figure 11 is a view showing a practical example of a distribution system according to the second embodiment. In this practical example, the same scenario is assumed as in the case of the practical example described with reference to Figure 6. As described above, client 3 consisting of a vehicle-mounted information terminal is in the course of traveling from the Tokyo area for participation in an event held in the Kanagawa area. Also, it will be assumed that there are a large number of participants in this event from the Tokyo area, with the result that requests to parent server 1 for distribution of the Kanagawa MAP increase.

In this case, when generation of a copy list 10 in respect of the Tokyo Information Center (child server 2b) is performed at parent server-side device 4, this Kanagawa MAP is listed; in the event of an inquiry from child server-side device 5, the Kanagawa MAP is also copied and registered

at the Tokyo Information Center (child server 2b).
Since a statement to this effect is recorded in
the location information 7 of parent server 1, it
is made possible to carry out distribution from
5 the Tokyo Information Center (child server 2 b) in
response to any subsequent request for
distribution of the Kanagawa MAP from the Tokyo
area.

10 In this way, buffering of load concentration
onto parent server 1 and child server 2c of the
Kanagawa area having the Kanagawa MAP can be
achieved; however, in cases where the participants
in the event do not come just from the Tokyo area,
a similar situation may occur in a plurality of
15 other areas, so the benefit of employing the
present distribution device thereby becomes even
greater.

As described above, by the use of the
distribution system according to the second
20 embodiment, of the contents held by the parent
server 1, those items of contents which have a
high frequency of distribution requests are copied
onto the child server 2 that is closest to the
client 3 which originated this distribution, and
25 distribution of contents to client 3 is performed
from there. Load concentrations on to parent
server 1 and specified child servers 2 can thereby

be dispersed and, since copying of contents for this purpose is performed automatically, the provision of time for this purpose is unnecessary. Also, since copying of contents to the required location is effected when necessary, there is no need to copy all the contents on to all of the child servers 2, making it possible to utilize resources efficiently.

It should be noted that it is possible to employ a distribution system according to this embodiment in combination with a system according to the first embodiment. Also, although the above description was given with reference to a two-layer distribution mode, an identical distribution system could be employed even in a distribution mode with three or more layers. In this case, servers which are in an arbitrary directly above/directly below relationship operate positioned as the aforementioned parent server 1 and child servers 2, respectively.

Next, a third embodiment of a distribution system to which the present invention has been applied will be described. Figure 12 is a layout diagram of a distribution system according to the third embodiment. With this distribution system, contents in respect of which distribution requests from the associated area 9 have ceased or reduced

can be automatically deleted from child server 2.

As shown in Figure 12, a distribution system according to this embodiment, just as in the case of the first and second embodiments, has a two-layer distribution structure comprising a parent server 1, child servers 2 and clients 3. Child server coverage area 9 is the distribution range for which child server 2 is responsible; location information 7 and access log 8 hold the same contents as described with reference to the first embodiment. Also, access log 8' is an access log at the side of child server 2; the items logged are the same as in the case of the access log 8 at the side of parent server 1.

In this distribution system, child server-side device 5 is constantly actuated on child server 2 and checks for the existence of distribution requests in respect of each item of contents in the area 9 for which it is itself responsible by periodically checking access log 8' and notifies server 1 of contents (for example C01 in Figure 12) in respect of which no distribution requests have been made or in respect of which the frequency thereof is low. Parent server-side device 4 is continuously actuated on parent server 1, updates the location information 7 relating to contents that are to be deleted in accordance with

the notification from the child server 2, and communicates completion of updating to the child server 2 in question. On receipt of this communication, child server-side device 5 deletes from child server 2 in question contents in respect of which no distribution requests have been made or in respect of which the frequency thereof is low.

Figure 13 and Figure 14 are flowcharts illustrating the operation of a distribution system according to the third embodiment. The operation of this distribution system is described below with reference to these Figures and Figure 12. First of all, child server-side device 5 initializes deletion list 12 at fixed time intervals. Deletion list 12 is a list of contents, of the (global) contents that are copied from the side of parent server 1, that are to be deleted (step S1 of Figure 13). Next, respective processing is performed as follows in respect of all the contents copied from the side of parent server 1.

First of all, from access log 8', the number of accesses of the contents in question from within area 9 for which this child server 2 is responsible are counted (step S2 in Figure 13). Next, by a method such as dividing this access

number by the time for which the access log is
compiled, the frequency of access is calculated
(step S3 in Figure 13). If this calculated access
frequency is less than a previously set threshold
value (step S4 in Figure 13), a decision is made
that this item of contents is to be deleted, and
the name of this item of contents is added to the
deletion list 12 (step S5 in Figure 13). Although,
in the above description, the decision for
deletion was made using the access frequency, it
would be possible to make a decision to perform
deletion simply when the access number falls below
a prescribed value. For example, if this
prescribed value is set as 0, deletion of the item
of contents in question from child server 2 will
be performed if no distribution requests have been
made.

When deletion list 12 has been generated by
executing the above processing for all the items
of contents, this is sent to parent server-side
device 4 (step S6 in Figure 13). The deletion list
12 that is transmitted may be implemented by a set
of flags, each flag of which represents whether
each item of contents is to be deleted or not
respectively.

When parent server-side device 4 receives
deletion list 12, it checks to see whether the

child server 2 in question is recorded as having the item of contents in question in the location information 7 in respect of each of the items of contents therein (step S7 in Figure 14), and if this is recorded, deletes the record (step S8 in Figure 14). When updating of this location information 7 is completed, a message to the effect that the contents of deletion list 12 may be actually deleted is communicated to child server-side device 5 (step S9 of Figure 14). Once child server-side device 5 has received this notification, it actually deletes the contents contained in the deletion list 12 from child server 2 (step S10 in Figure 14).

Although in the above description a method was adopted in which deletion list 12 was generated at child server-side device 5, if a log of access to global contents in all the areas 9 is left in access log 8 at the side of parent server 1, a method may be adopted whereby the deletion list is generated at parent server-side device 4. Figure 15, Figure 16 and Figure 17 are views illustrating an operation flowchart of this case.

First of all, during operation, parent server-side device 4 generates a deletion list 12' in respect of each child server 2 at fixed time intervals. As shown in Figure 15, the procedure

for generating deletion list 12' (steps S1 to S6 of Figure 15) is practically identical with the procedure illustrated in Figure 13 described above (steps S1 to S5 of Figure 13), but processing to
5 check, by using location information 7, whether the child server 2 in question has the item of contents in question is added (steps S4 and S5 in Figure 15). Also, of the items of contents that have been added to the deletion list 12', the
10 record that the item of contents in question is held by child server 2 in question is deleted from location information 7 (step S7 of Figure 15).

Next, child server-side device 5 periodically executes an inquiry directed to parent server-side
15 device 4 as to the existence of distribution requests from the area 9 for which it is responsible, in respect of the contents copied from parent server 1 (step S8 in Figure 16). After receiving this inquiry, parent server-side device
20 4 ascertains the child server 2 that originated the inquiry (step S9 in Figure 16), and checks to establish whether or not the item of contents that is to be deleted is present on the deletion list 12' corresponding to this child server 2 (step S10
25 in Figure 16). If it is indeed present, it returns the deletion list 12' to the child server-side device 5 that originated the inquiry (step S11 of

Figure 16). In this case also, for deletion list 12', the method of implementation by a set of flags as described above may be adopted.

When child server-side device 5 has received deletion list 12', it initializes the deleted list 13, constituting information as to the items of contents that have already been deleted (step S12 in Figure 16). Next, for each of the items of contents contained in deletion list 12', it deletes these items of contents from the child server 2 in question (step S13 in Figure 16), and adds the name of the deleted item of contents to the deleted list 13 (step S14 in Figure 16). If processing has been completed in respect of all the items of contents in deletion list 13, deleted list 13 is transmitted to parent server-side device 4, and this is notified of completion of deletion (step S15 of Figure 16). Just as in the case of deletion list 12', the method of implementation using a set of flags may be adopted for deleted list 13. Also, the method may be adopted of notifying parent server-side device 4 every time an item of contents is deleted at child server 2.

Once parent server-side device 4 has received notification of completion of deletion, for each item of contents contained in the deleted list 13,

it deletes the contents in question from deletion list 12' in respect of the child server 2 that originated the notification (step S16 in Figure 17) and also verifies that there is no record in location information 7 of the child server 2 that originated the communication having the item of contents in question (step S17 in Figure 17).

Although, in the above description, a method was described wherein inquiry is periodically made from the side of child server 2, it would be possible to adopt a method in which deletion of contents is prompted by accessing child server 2 periodically from the side of parent server 1 in conjunction with generation of the deletion list 12' at parent server-side device 4 described with reference to Figure 15.

Figure 18 is a view showing a practical example of a distribution system according to a third embodiment. In this practical example, a scenario similar to that of the practical example described with reference to Figure 6 and Figure 11 is assumed. That is, it is assumed that an event that was held in the Kanagawa area has finished, and that accesses to the Kanagawa MAP from clients 3 (vehicle-mounted information terminals) situated in the Tokyo area have ceased.

In this case, since there are scarcely any

records of access of the Kanagawa MAP in the
access log 8' of the Tokyo Information Center, the
Kanagawa MAP is put on the deletion list 12
compiled at the child server-side device 5b, with
5 the result that, after updating of the location
information 7 at the side of parent server 1, the
Kanagawa MAP is deleted from child server 2b
(Tokyo Information Center).

As described above, by employing the
10 distribution system according to the third
embodiment, contents in respect of which requests
for distribution are few can be automatically
deleted from child server 2, making it possible to
achieve efficient utilization of resources at the
15 server and making administrative action to perform
deletion unnecessary. Also, it can be employed
together with a system according to the first
and/or second embodiment. In this case, contents
held by the child server 2 can be dynamically
20 added/deleted in response to dynamically changing
distribution requests, making it possible to
distribute contents of high request frequency
efficiently to clients 3 from child server 2. An
even more refined distribution system is thereby
25 constituted. It should be noted that, just as in
the case of the other embodiments, even in the
case of a distribution configuration comprising

three or more layers, a similar realization of contents can be achieved between servers that are in parent server/child server relationship.

With a distribution system according to the first, second and third embodiments described above, load concentration on the parent server and network connected to the parent server can be avoided without having to copy all the global contents to all the child servers. Also, since the changeover of distribution source server for this purpose and copying/deletion of contents are performed automatically, the administrative load on the server manager and client users can be alleviated.

The scope of protection of the present invention is not restricted to the embodiments described above but extends to the invention set out in the claims and equivalents thereof.

As described above, according to the present invention, the source of contents distribution is automatically changed over to the child server that is closest to the client originating the request, and copying of contents onto the child server and deletion of contents from the child server are performed automatically in accordance with the frequency etc of distribution requests. Consequently, the amount of the information to be

transferred between the clients and the parent
server can be reduced, the load on the parent
server and network connected to the parent server
can be alleviated, and the burden on the managers
5 and users of the distribution system can be
alleviated. Also, there is no need to hold
contents whose frequency of use is low on the
child server, so the beneficial effect is achieved
of making it possible to utilize the child server
10 resources efficiently.